997.116

PATENT SPECIFICATION

DRAWINGS ATTACHED

997.116

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Int. Cl.:—F 25 d

COMPLETE SPECIFICATION

Apparatus for Cooling Chocolate Compositions

I, ROBERT SOLLICH, a German citizen, of Auf der Breden 12, Bad Salzuflen, Germany, do hereby declare the invention, for which I pray that a Patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a cooling device for chocolate composition, for example a chocolate coating, with the aim of cooling the chocolate composition, which is present in the form of a bar or coating and which is necessarily tempered, until it has fully solidified.

It is known that after a chocolate composition has been formed into bars, hollow articles or coatings, it must be cooled in a controllable manner. The main purpose of this cooling is to provide that the stable cocoa butter crystallisation initiated in the preceding tempering process is aided by the removal of heat only to such an extent as is compatible with complete solidfication in the desired stable and fine crystalline structure of the cocoa butter. The removal of heat during solidification of the chocolate must bear an approximate relationship to the amount of latent heat liberated. Sudden vigorous cooling may lead to spontaneous solidification in an unwanted crystalline form with the result that the chocolate product becomes "grey". Such products are then not saleable.

Several types of cooling are known. One apparatus provides a cooling duct through which a conveyor belt carrying the pieces of chocolate or of chocolate coated products is moved and in which cold air at a temperature of about 5° to 6°C. is blown over the conveyor belt by means of fans. This form of cooling is very inaccurate and superficial. Firstly, the temperature and air currents of the cooling air are difficult to control in the cooling duct, so that it repeatedly occurs that products on one side of the belt are more strongly or less thoroughly cooled than on the other. Secondly, cooling by air causes a thin outer layer to solidify first. The latent heat of the inner layer which solidifies later is thus forced to penetrate the outer layer which has already solidified, with the result that this outer layer partly melts again. Externally, this is manifested in the so-called "fat frost" which gives the chocolate product a grey and fatty appearance. To this is added the fact that with this method of cooling, the conveyor belt (wax cloth) is hardly cooled at all and the products are generally unsatisfactory.

Another process has become known in America, in which the heat radiated by the pieces of chocolate is absorbed by blackened and cooled surfaces. It has been found that this type of cooling, termed radiation cooling, has considerable advantages as compared with the convection cooling mentioned above, although no completely satisfactory apparatus has been devised for carrying out this process.

In one apparatus which has become known, cooling plates are arranged horizontally above and below the conveyor belt. However, this has the disadvantage that the conveyor belt must be made of material which is permeable to radiation, and such belts by no means fulfil the requirements of durability and permeability. Since the cooling plates must be kept relatively cool owing to their small surface area, water of condensation quickly forms on them, and this involves the risk of droplets of water falling on to the chocolate products. To prevent this, a polyethylene foil permeable to heat rays has been stretched between the conveyor belt and the upper cooling plate for the purpose of catching the water droplets. However, it was found in practice that a thin layer of dust which considerably reduces the efficiency of

radiation cooling is formed after a short time on the upper surface of the lower cooling plate as well as on the polyethylene foil.

According to this invention there is provided apparatus for cooling chocolate composition wherein a cooling chamber encloses a conveyor for carrying the composition through the chamber, a cooled surface below the conveyor, blackened and finned cooling members arranged in substantially vertical planes one on each side of the conveyor, and deep cooled surfaces cooled to a temperature lower than the cooling members, whereby the latent and sensible heat of the composition is transferred by indirect heat exchange from the underside of the composition to the cooled surface below the conveyor, and the heat radiated by the composition is absorbed by the cooling members, the deep cooled surfaces preventing deposition of water of condensation on the composition and on the cooling members.

The invention will now be explained with the aid of a constructional example of a coating-cooling apparatus, with reference to the accompanying drawings, in which:—

Figure 1 is a general side elevation;

Figure 2 is a longitudinal section through a radiation cooling duct;

Figure 3 is a section on the line III—III in Figure 2; and

Figure 4 is a section on the line IV—IV in Figure 2.

Figure 1 shows a coating machine 1 which applies the chocolate coating on fillings 2. Chocolate coated pieces 3 are conveyed from the conveyor grid inside the coating machine 1 to an endless cooling belt 4 on which they pass through the cooling duct 5 in which the chocolate coating is solidified on all sides by cooling. At the end of the cooling duct there is preferably arranged a drive 6 which drives the belt at variable speed. Both at the inlet and the outlet to the cooling duct 5 there is an adjustable flap 7 by which the duct can be closed as far as possible, depending on the size of the coated pieces 3, to prevent entry of air. Apart from a small central portion 8 which contains the cooling compressor 9 and a heat exchanger 10, the duct 5 is clear of the ground i.e. it is mounted on stands 11 of adjustable height situated at intervals.

The radiation cooling duct (Figures 2, 3 and 4) is composed of the following main parts:

A cooling chamber 12 proper with finned and blackened cooling tubes 13 arranged on each side of the conveyor belt 4, evaporator tubes 14, reflectors 15 (Figures 3 and 4) which are suspended in the duct over the whole length thereof, and cooling tubes 16 arranged underneath the belt 4. The cooling medium 17, preferably water, is contained in a heat exchanger 10 and is circulated through the cooling tubes 13 and 16 by a pump 18. The radiation cooling duct 5 is made entirely of steel and protected against loss of heat by means of a thick insulating layer 19. As shown in Figures 3 and 4, the inner surface of the insulation 19 is provided with aluminium foil 20 which reflects substantially all the heat rays impinging on it.

The conveyor belt 4 together with the chocolate pieces 3 on it moves over a plate 21 which is continuously cooled from below by contact cooling, preferably by means of flat tubes 16 cooled by water. All joints between the plate 21 and tubes 16 are coated with a heat conductive material 29, e.g. Thermon, so that the plate 21 is cooled uniformly over its whole surface. This ensures intensive bottom cooling.

In the upper cooling chamber 12, finned cooling tubes 13 having a large surface area are arranged horizontally in vertical rows on each side of the conveyor belt 4 over the substantially whole length of the cooling duct 5. The cooling tubes 13 are blackened and matt and thus ensure complete absorption of the heat rays impinging on them. By finning the cooling surface, the surface area is increased by 10 to 20 times. Parabolically or concavely curved reflectors 15, which are provided with aluminium foil on their undersurface and thus reflect all heat rays impinging on them, are suspended between the two vertical columns of cooling members 13, also over the whole length of the cooling duct 5. The reflectors 15 must be so formed (Figures 3 and 4) that all the heat radiated to them is reflected to the cooling members 13.

At the beginning and end as well as in the middle of the cooling duct 5 (Figures 2 and 4), finned evaporator tubes 14 are arranged on both sides of the conveyor belt 4. These tubes 14 are cooled to a very low temperature by a cooling plant consisting of a compressor 22 and condenser 23, preferably by means of the gaseous cooling agent Frigen (Registered Trade Mark). A fan 24 causes a slow movement of air over the finned evaporator tubes 14 and along surfaces 25 which are cooled by radiation from tubes 14. Atmospheric moisture is condensed on the cold surfaces 14 and 25. Water of condensation is trapped in channels 26 and conducted away through small tubes 27.

The finned tubes 13 and the flat tubes 16 are preferably cooled by water. A water cooling apparatus is installed for this purpose in the middle part 8, Figure 1. It comprises (Figure 2) the compressor 9, preferably suitable for use with Frigen (Registered Trade Mark), the condenser 30, the heat exchanger 10 containing evaporator coils 31 and the circulating pump 18 for cooling water.

The gaseous cooling agent is compressed in the compressor 9, liquefied in the condenser 30 and passes from there through an expansion valve 32 into the evaporator coils 31 where it is evaporated again, taking the heat of evaporation from the water 17. The water 17 which is thereby cooled is conveyed by the pump 18 through the control valve 33 to the tubes 13 and 16. The output of the water cooling plant (9, 10, 31, 18) is so designed that the tempering apparatus (not shown) in the coating plant 1 can also be supplied with cooling water 17 from the closed water circulation. The radiation duct 5 operates as follows:

The heat rays of the sensible and the latent heat radiated from the chocolate coated pieces 3 impinge either directly on the blackened finned cooling tubes 13 and are absorbed, or on the reflectors 15 which reflect them to the finned cooling tubes 13. The heat taken up is removed by the cooling water 17 circulating through the tubes 13. The heat produced at the bottom of the coated pieces 3 is given off to the conveyor band 4 and is thus conveyed by contact cooling to the cooling water 17 circulating through the flat tubes 16. The heat supplied at various points to the cooling water 17 is removed in the heat exchanger 10.

Atmospheric moisture, which hitherto gave rise to difficulties in cooling ducts, is condensed by the deep cooled evaporator coils 14 and the moisture is thus prevented from condensing on the tubes 13 or on the chocolate coated pieces 3.

WHAT I CLAIM IS:—

1. Apparatus for cooling chocolate composition wherein a cooling chamber encloses a conveyor for carrying the composition through the chamber, a cooled surface below the conveyor, blackened and finned cooling members arranged in substantially vertical planes one on each side of the conveyor, and deep cooled surfaces cooled to a temperature lower than the cooling members, whereby the latent and sensible heat of the composition is transferred by indirect heat exchange from the underside of the composition to the cooled surface below the conveyor, and the heat radiated by the composition is absorbed by the cooling members, the deep cooled surfaces preventing deposition of water of condensation on the composition and on the cooling members.

2. Apparatus according to claim 1, wherein concave or parabolically shaped reflectors reflect heat impinging on them on to the cooling members.

3. Apparatus according to claim 2, wherein the surfaces of the reflectors are lined with foil substantially impermeable to radiation.

4. Apparatus according to any preceding claim wherein the chamber is lined with a heat insulating jacket.

5. Apparatus according to claim 4 wherein the jacket is lined internally with foil substantially impermeable to radiation.

6. Apparatus according to claim 3 or claim 5 wherein the foil is aluminium foil.

7. Apparatus according to claim 1, wherein the cooled surface is a plate cooled by flat tubes through which cooling medium circulates.

8. Apparatus according to claim 7, wherein the flat tubes are coated in such a manner with heat conductive material that the temperature is substantially uniform over the whole width of the plate.

9. Apparatus according to any preceding claim wherein the cooling members are horizontally disposed finned tubes of large surface area.

10. Apparatus according to any preceding claim wherein coolant water for cooling the cooling members and the cooled surface below the conveyor is constantly cooled to the required temperature in a closed circuit by means of a heat exchanger.

11. Apparatus according to claim 10, wherein the coolant water is circulated by a pump.

12. Apparatus according to any preceding claim wherein the deep cooled surfaces are evaporator pipes.

13. Apparatus according to claim 12, wherein a fan accelerates the "drying" of the air in the cooling chamber.

14. Apparatus according to claim 1, wherein the cooling chamber is supported clear of the ground, by stands of adjustable height.

15. Apparatus for cooling chocolate composition substantially as herein described, with reference to the accompanying drawings.

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Fig. 1

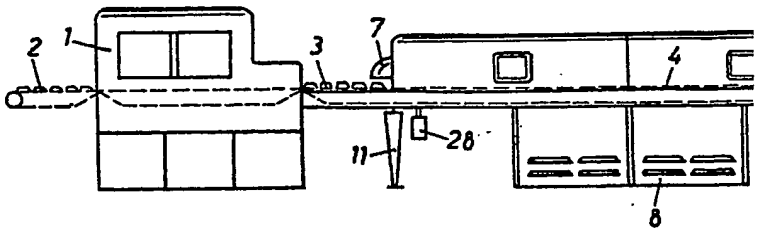
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Fig. 2

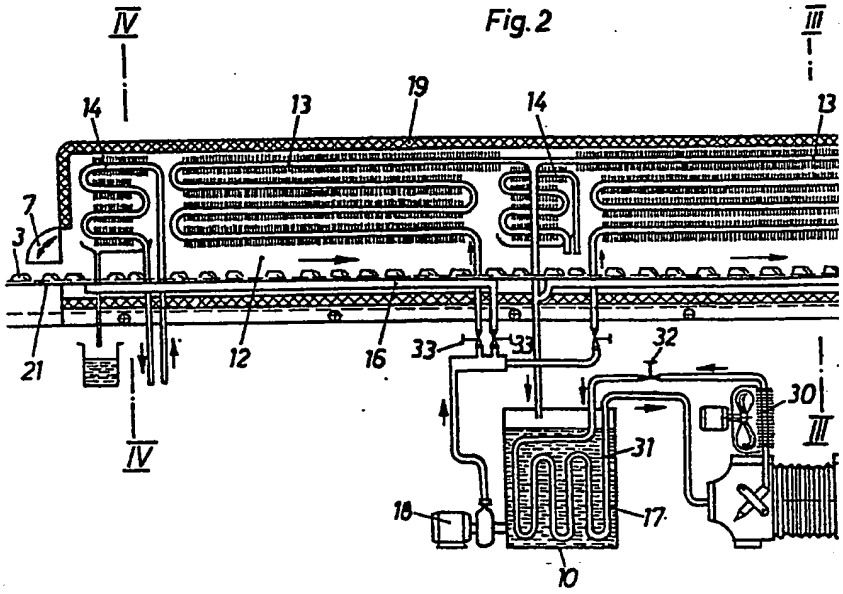
IV
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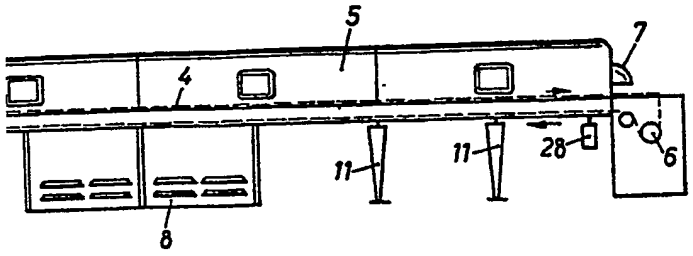
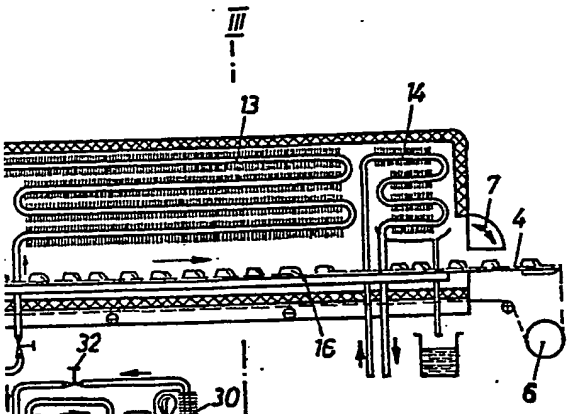
Fig. 1





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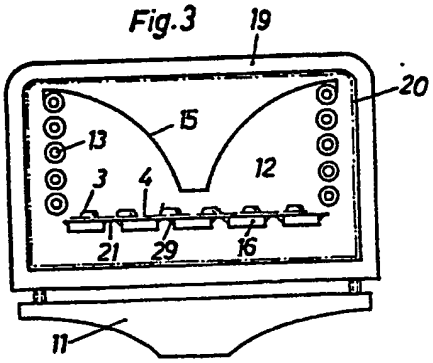

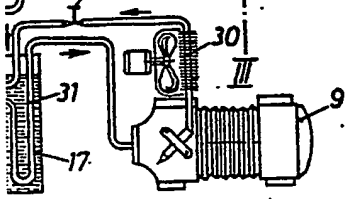

Fig. 4

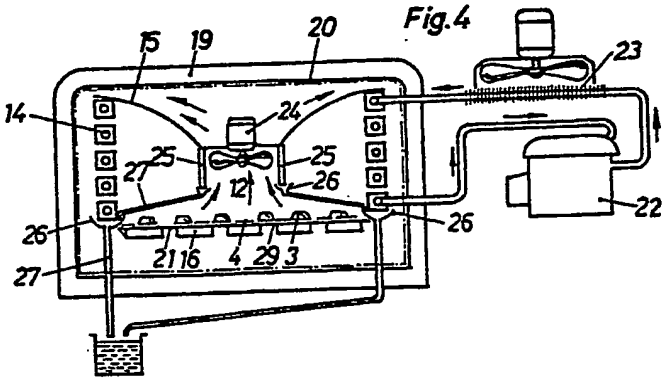

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Fig. 1

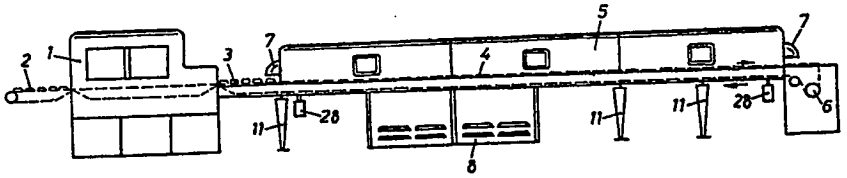

Fig. 2

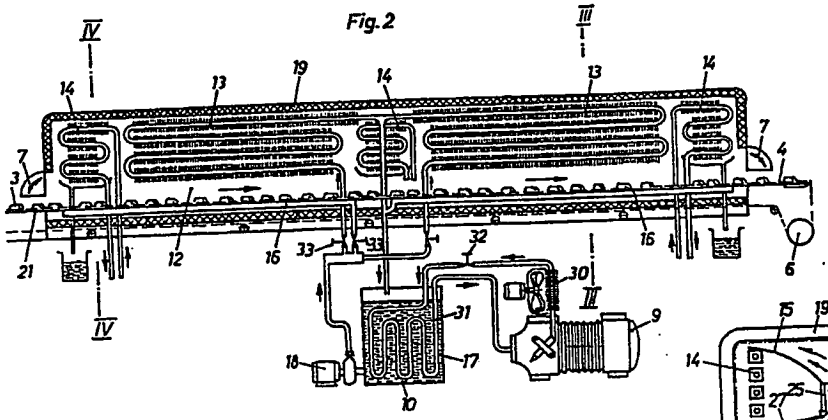

Fig. 3

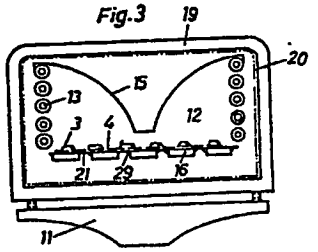

Fig. 4